DETAILED ACTION

Status

1. Claim 12 are improperly identified as previously presented, but should properly be indicated as withdrawn.

Claim Objections

2. Claim 3 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim, or amend the claim to place the claim in proper dependent form, or rewrite the claim in independent form. The instant claim requires that the material exhibit a nanocrystalline structure, but fails to further limit independent claim 1 from which it depends. Claim 1 requires that the organometallic included in the material display a nanocrystalline structure, and therefore the requirement of the instant claim that the material displays a nanocrystalline structure is not considered to be further limiting.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

5. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

6. Claims 1, 3, 5 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jensen et al. (US 2001/0051130) in view of Schulz et al. (US 5906792).

In regard to claims 1 and 3, Jensen discloses a hydrogen storage material that comprises an aluminum hydride and a catalyst. The aluminum hydride may be magnesium aluminum hydride ($Mg(AlH_4)_2$) with suitable organometallic catalysts containing Zr or V (paragraph 24). A preferred catalyst is $Zr(OPr)_4$ (zirconium tetra-n-propoxide) in crystalline form (paragraph 49). The material is formed by dry homogenizing the hydride and the catalyst by grinding in an inert atmosphere (paragraph 25). The catalyst is not disclosed to be nanocrystalline.

Schulz discloses a nanocrystalline composite for hydrogen storage. The nanocrystalline structure enhances the kinetics of the hydrogen diffusion (column 4,

lines 27-31). The nanocrystalline structure is obtained by grinding the raw materials used to form the composite in an inert atmosphere (column 4, lines 37-51).

It would have been obvious to one of ordinary skill in the art at the time of the invention to produce the material described by Jensen with a nanocrystalline structure. Such a modification would have been motivated by the teaching in Schulz that the diffusion kinetics of hydrogen storage materials may be enhanced by grinding to impart a nanocrystalline structure and the teaching in Jensen that the material is formed by grinding (paragraph 25).

7. In regard to claims 5 and 6, Jensen discloses that the preferred content of the catalyst is 0.5-1 mol% (paragraph 26).

Response to Arguments

8. Applicant's arguments filed 1/20/2010 have been fully considered but they are not persuasive.

The argument that the material disclosed by Jensen does not include a metal catalyst in the form of an organometallic compound as required by the instant claims is not persuasive. The teachings of the prior art that applicant has identified as supporting this assertion are directed to the characteristics of a material produced utilizing $Ti(OBu)_4$ as a catalyst precursor. It is agreed that these passages indicate that the material produced utilizing $Ti(OBu)_4$ as a catalyst precursor does not include the catalyst in organometallic form. However, the rejection of the instant claims is not predicated on the Ti containing material disclosed by Jensen but on the material produced utilizing $Zr(OPr)_4$. Jensen does not disclose that the material produced using $Zr(OPr)_4$ is free of

carbon, or that the organic component is eliminated during the production process. The Ti containing material disclosed by Jensen is taught to exhibit a color change during the grinding process that coincides with the elimination of the organic components of the catalyst precursor (paragraph 27), but no similar physical change is taught for the Zr containing material. The teaching in Jensen that the Zr containing material exhibits a catalytic mechanism that is different from the catalytic activity displayed by the Ti containing material indicates that the two materials are dissimilar in character. Additionally, the material disclosed by Jensen is produced utilizing similar materials in the same process, grinding, under the same conditions, argon atmosphere, as the material required by the instant claims, and therefore the process disclosed by Jensen would be expected to produce a product similar to the material required by the instant claims. The grinding process disclosed by Jensen would appear to one of ordinary skill in the art at the time of the invention to meet all the requirements of the process described in the instant specification as necessary for the production of a material meeting the requirements of the instant claims. There is no express evidence in the disclosure of Jensen that the material produced utilizing $Zr(OPr)_4$ does not contain Zr in an organometallic form as required by the instant claims.

The argument that the organometallic catalyst material utilized by Jensen does not display a nanocrystalline structure as required by the instant claims is not persuasive. It is well established in the art that when in solid form $Zr(OPr)_4$ exhibits a crystalline structure. The material interaction between the material disclosed by Jensen and hydrogen is described as a gas-solid interaction which would indicate to one of

ordinary skill in the art at the time of the invention that the material disclosed by Jensen is in solid form (paragraph 53). One of ordinary skill in the art would then recognize that at some point during the processing the $Zr(OPr)_4$ utilized in the process in the form of a propanol solution would be converted to a solid. Schulz discloses that hydrogen storage materials with a nanocrystalline structure exhibit enhanced hydrogen diffusion kinetics. As set forth in the rejection of the instant claims, one of ordinary skill in the art at the time of the invention would have been motivated to produce the material disclosed by Jensen with a nanocrystalline structure by the teachings of Schulz. Such a material would be a nanocrystalline solid. The material disclosed by Jensen in view of Schulz is nano-sized solid and because it is well known that solid $Zr(OPr)_4$ exhibits a crystalline structure the $Zr(OPr)_4$ contained within the nano-sized material would necessarily display a nanocrystalline structure as required by the instant claims.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of

the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to KEVIN M. JOHNSON whose telephone number is (571)270-3584. The examiner can normally be reached on Monday-Friday 9:00 AM to 5:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Curtis Mayes can be reached on 571-272-1234. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Kevin M Johnson/
Examiner, Art Unit 1793

/David M Brunsman/
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